FORUM

Breeding Better Fruits and Veggies

On any given day, the amount and diversity of produce available to U.S. consumers is awe inspiring. To ensure this bounty requires dedicated plant-genetics and breeding research designed to enable farmers and producers to supply high-quality produce for as much of the year as possible.

Look at strawberries, for example. It takes production on two coasts and several varieties to provide these favorites to the nation's consumers for most of the calendar year.

The Agricultural Research Service's Plant Genetic Resources, Genomics, and Genetic Improvement national program (NP #301)—the largest of ARS's 18 national programs—has 177 research projects and a staff of 350 scientists. The program has three components: crop genetic improvement, crop genetic and genomic resources and information management, and crop biological and molecular processes. Its goals are to enhance American agricultural productivity and to ensure a high-quality, safe supply of food, fiber, feed, ornamentals, and industrial products.

To achieve these goals, researchers are breeding improved germplasm and superior crop varieties, developing and applying new genetic and bioinformatic tools, and safeguarding and developing plant genetic resources and associated genetic and genomic databases.

Improving crops often requires developing and accessing new genetic resources. Over the past 60 years, ARS has committed to conserving and managing a broad array of plant and plant-associated microbial genetic resources. In the United States, there are currently 22 genebanks that are used to manage the national plant germplasm collections. These germplasm collections help ARS scientists and other researchers develop breeding stock and new crop varieties to enable crop breeders,

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growers, and producers to meet the needs of a changing world.

Crop production in the United States is challenged by emerging threats from diseases, pests, and environmental extremes; rapidly shifting consumer needs and preferences; expanding needs for bioenergy feedstocks; and the need to ensure that crop products are safe and of high quality.

ARS scientists are conducting genetic research to help plant breeders incorporate genes from ancestral and wild relatives of crop plants. This often includes prebreeding to eliminate undesirable traits that may tag along. The scientists have developed new tools, such as more effective marker-assisted breeding approaches and revolutionary new statistical genetic and genomic methods. They have put these tools and information to good use by developing a host of new varieties and germplasm lines for a full spectrum of U.S. crops, from *Allium* crops, like onions and garlic, to *Zea mays,* or corn.

In Kearneysville, West Virginia, ARS researchers found, in plums, that introducing a poplar tree gene that promotes earlier flowering and fruiting shortened the juvenile stage from 3 to 4 years to less than 1 year. This method, termed "FasTrack," can significantly accelerate the breeding of new and improved tree-fruit varieties.

ARS researchers also respond to emerging agricultural threats, such as Ug99 stem rust, a virulent plant disease threatening wheat and barley crops in Africa, the Middle East, and Asia. This disease can cause crop losses of up to 100 percent when cultivars have no resistance. Ug99 may spread broadly throughout these regions and has the potential to reach beyond them.

In Ames, Iowa, ARS researchers and university cooperators have analyzed resistance to the Ug99 stem rust strain in barley using genome-wide expression profiling, combined with genetic mapping. They identified a "master switch" that regulates the expression of hundreds of Ug99-responsive genes and demonstrated that the genetic location of the switch also confers enhanced adult-plant resistance. Further research on the master switch and development of allele-specific markers can lessen the threat of Ug99.

In Beltsville, Maryland, ARS researchers and their university colleagues bred Peter Wilcox, a fresh-market potato with dark-purple skin, yellow flesh, and a carotenoid content more than 15 percent greater than that of Yukon Gold, the current standard yellow-flesh variety in the country. This new variety provides growers and consumers with a unique combination of skin and flesh colors for niche markets.

These are just a few examples of the work ARS has done, and continues to do, to provide improvements in crops for the benefit of U.S. agricultural producers and consumers.

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